

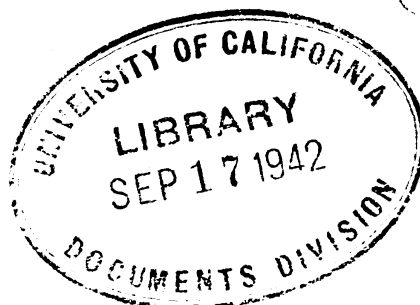
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1918 **WAR DEPARTMENT**

TECHNICAL MANUAL

THE MOTORCYCLE
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TECHNICAL MANUAL
No. 10-515

WAR DEPARTMENT,
WASHINGTON, December 13, 1940. ★ ★

THE MOTORCYCLE

Prepared under direction of
The Quartermaster General

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SECTION I

GENERAL

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1. General.—*a.* The motorcycle is perhaps the least understood and for that reason the most abused vehicle used in the military service. This manual is essentially intended to provide basic information on its employment and limitations; its characteristics; and instructing and training personnel for its operation and maintenance.

b. Efficient motorcycle operation, good maintenance, and servicing are possible only with well-trained and disciplined motorcyclists.

2. Types of motorcycles.—There are three general types of motorcycles available for military use. They are—

Solo motorcycle (fig. 1).

Motorcycle with side car (fig. 2).

Motor tricycle (fig. 3).

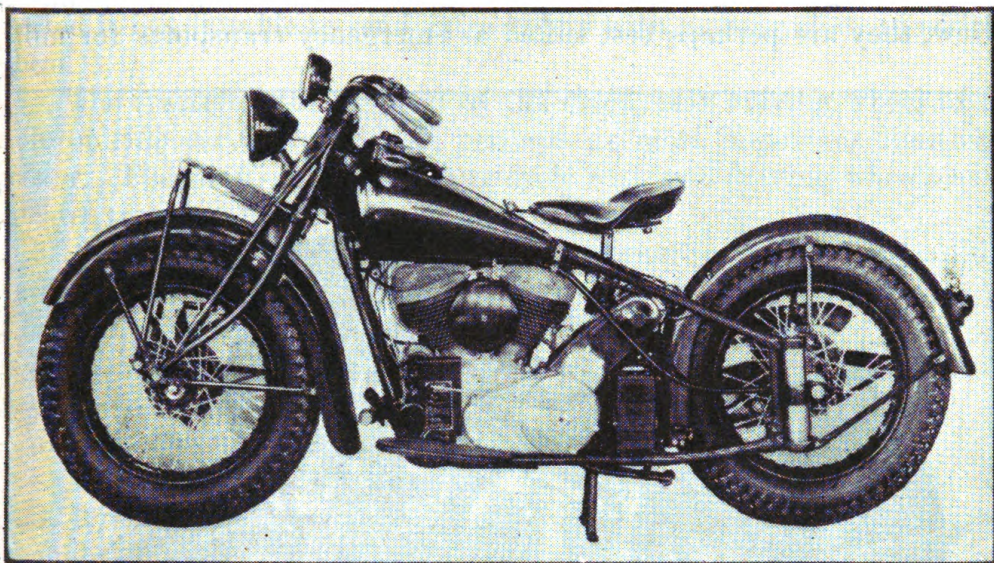


FIGURE 1.—Solo motorcycle.

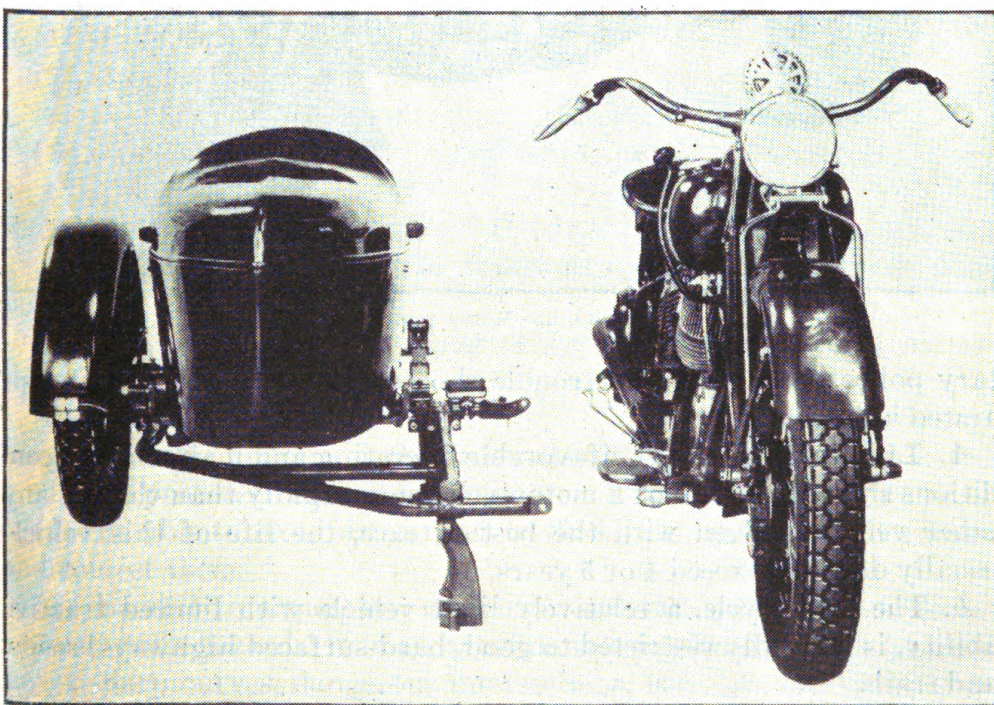


FIGURE 2.—Motorcycle with side car (not connected).

3. **Employment.**—*a.* The solo motorcycle requires a driver with an excellent sense of balance. It is best adapted to highway police and traffic control uses and is also well suited for messenger service and for carrying light compact articles.

b. The motorcycle with side car and the motor tricycle are suitable for carrying packages or extra passengers. From a military point of view, they are perhaps best suited as emergency transports for mili-

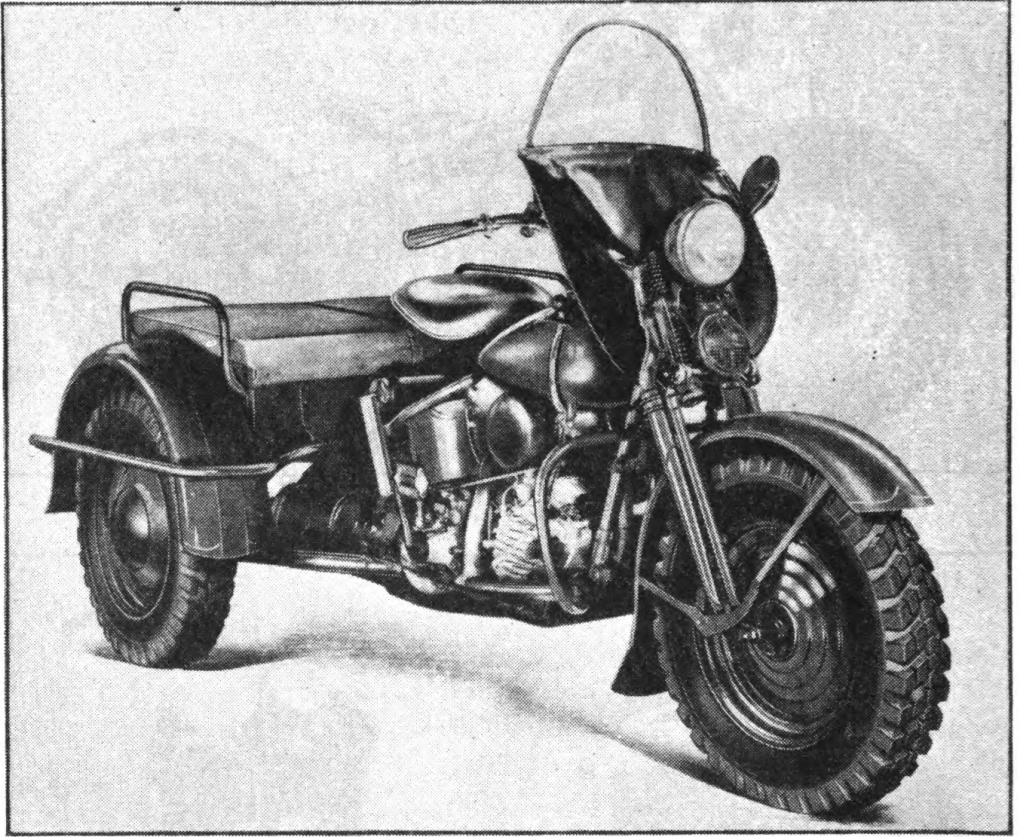


FIGURE 3.—Motor tricycle.

tary police, mechanics and trouble shooters, and supervisors of separated activities.

4. **Limitations.**—*a.* Unfavorable operating and maintenance conditions shorten the life of a motorcycle more rapidly than that of any other vehicle. Even with the best of care, the life of this vehicle usually does not exceed 4 or 5 years.

b. The motorcycle, a relatively light vehicle with limited tractive ability, is normally restricted to good, hard-surfaced highways, roads, and trails.

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c. Operating a motorcycle on icy, wet, and slippery surfaces is difficult and extremely hazardous because it tends to go out of control or skid at the slightest change of road condition, speed, or direction.

d. The cross-country ability of the motorcycle is limited by mud, sand, soft or rocky stream bottoms, deep ditches, heavy roots, bad bumps, holes, and underbrush. When such conditions are expected it is advisable to send extra riders with motorcyclists to assist them.

e. The tractive effort exerted by the single rear driving wheel of a solo or side car motorcycle is perhaps its most important limiting factor. The shaft-driven motor tricycle with two driving wheels has greater tractive effort.

5. Qualifications of drivers.—In addition to having the qualifications of an excellent soldier, a motorcyclist should—

- a.* Be interested.
- b.* Be a quick, clear, and logical thinker.
- c.* Have initiative.
- d.* Have mechanical ability.
- e.* Be adaptable.

6. Training drivers.—The training of the military motorcyclist should include the usual training given any motor vehicle operator in the rules of the road, safety, and vehicle control under all conditions.

a. As a motorcyclist, the driver should be trained to know—

- (1) Capabilities of the motorcycle.
- (2) Nomenclature.
- (3) Operation (use of controls).

(4) First echelon inspection and maintenance of his vehicle under all conditions.

b. As a messenger (or courier), the driver should be trained in—

(1) Correctly receiving and transmitting verbal or written messages.

(2) The necessity for avoiding delays and for completing his assigned task.

(3) Reading road maps.

c. As a traffic policeman, the driver should be trained to—

(1) Be proficient in map reading.

(2) Be able to recognize serious traffic blocks, analyze their causes, and correct them.

(3) Be able to anticipate, recognize, and take protective measures against such hazards to march columns as railroad crossings, bad turns, sharp curves, dangerous intersections, bad detours, icy or slip-

pery roads, reckless driving, steep grades, and heavy opposing traffic streams.

- (4) Be able to render first aid.
- (5) Be cooperative and keep traffic moving.

SECTION II

NOMENCLATURE AND MAINTENANCE

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7. General.—*a.* Figures 4, 5, and 6 illustrate the nomenclature of the motorcycle.

b. The motorcycle is usually driven by an air-cooled, four-stroke, two-cylinder V-type internal combustion engine. This engine operates on the same basic principles as any internal combustion gasoline engine.

8. Pistons and rings.—*a.* The life of pistons and rings is highly variable. It depends on service conditions, the care given engine, and the manner in which the motorcycle is operated. The principal factors tending to shorten the life of pistons and rings are—

- (1) Overheating due to extremely hard use or to an improperly tuned engine.
- (2) Operating on dusty or sand roads and neglecting the carburetor air cleaner.
- (3) Using poor quality oil or not changing oil frequently enough.
- (4) Accelerating to high speeds (especially in low and second gear) directly after starting while engine is still cold.
- (5) Excessive carburetor choking.
- (6) Faulty spark plugs.

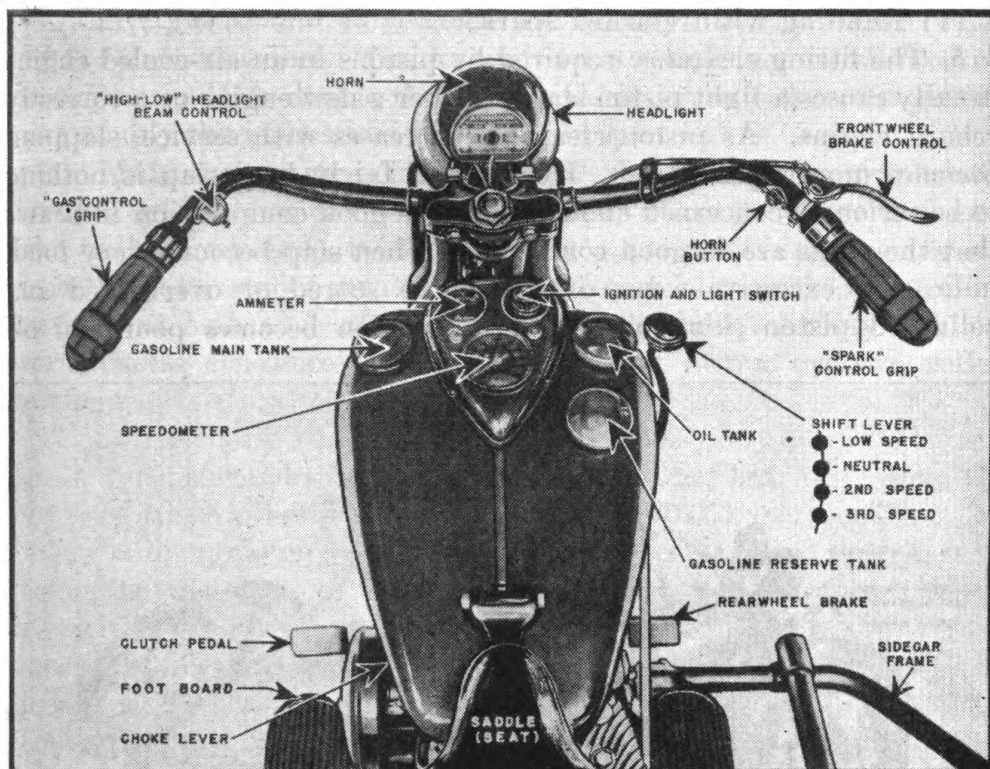


FIGURE 4.—Motorcycle from driver's saddle (seat).

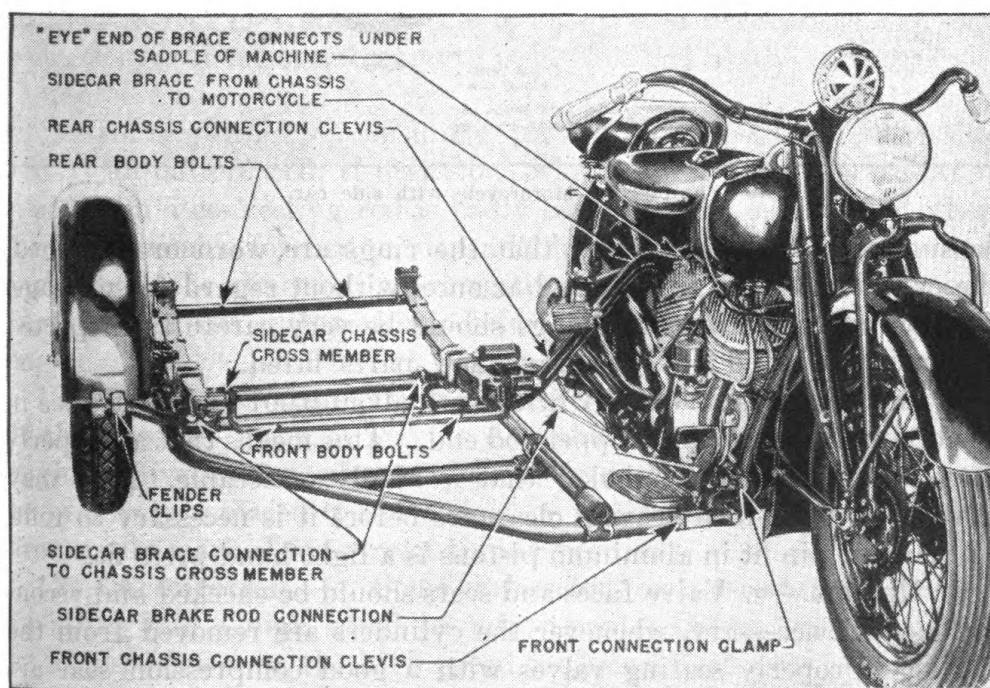


FIGURE 5.—Motorcycle and side car chassis.

(7) Running with retarded spark.

b. The fitting clearance required by pistons in an air-cooled engine usually causes a light piston slap in either a new engine or a correctly rebuilt engine. As piston clearance increases with service, slapping becomes more pronounced. However, a fairly loud slap is nothing to be seriously concerned about as long as good compression indicates that the rings are in good condition. When slap becomes very loud, indicating excessive wear, or possibly a scored or overheated and collapsed piston skirt, or when compression becomes poor and oil

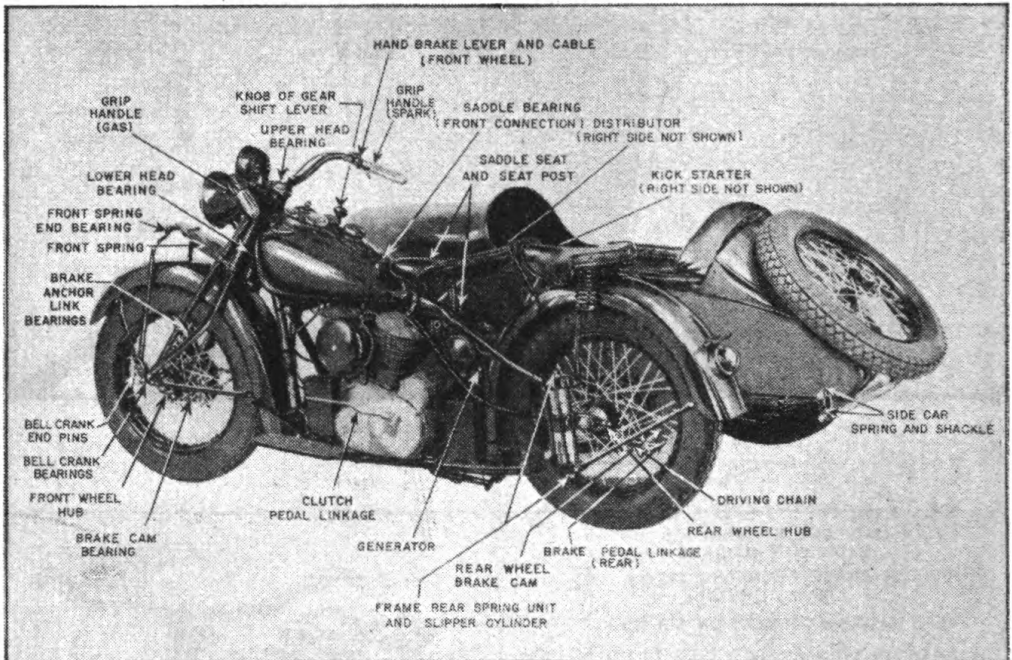


FIGURE 6.—Motorcycle with side car.

consumption high, indicating that the rings are worn or damaged, the cylinders should be removed at once, without regard for mileage. The cylinders, pistons, and rings should be very carefully inspected and measured and any necessary new parts fitted.

c. Piston pins are normally fitted with about 0.001-inch clearance in the bronze bushing of the upper rod end. This means that a properly fitted pin will have a "shake" that is barely noticeable. Pins may have up to 0.002-inch bearing clearance before it is necessary to refit. The correct pin fit in aluminum pistons is a light hand press fit.

9. Valves.—a. Valve faces and seats should be checked and reconditioned, if necessary, whenever the cylinders are removed from the engine. Properly seating valves with a good compression seal are very important to good engine performance.

b. Valve guides and valve stems are usually fitted with 0.003-inch to 0.004-inch clearance. Guides and stems should not be allowed to develop more than double their original clearance before the guides (or possibly the guides and valves) are replaced.

10. Main bearings.—The sprocket shaft end of the crankshaft flywheel assembly is supported by a roller bearing. The other end (the timing-gear end) is supported by a plain bushing bearing on some 1936 and earlier models. All 1937 and later models use roller bearings at both ends of the crankshaft flywheel assembly. When worn, excess clearance can be taken up by fitting oversize roller bearings.

11. Connecting rods.—*a.* Connecting rods are of the male and female type, assembled to one crank pin and roller bearing. Connecting rods are originally fitted approximately 0.001 inch loose on the rollers and crank pin. The upper end of connecting rods have a maximum side shake of $\frac{1}{16}$ inch with this bearing clearance. When appreciable up-and-down play can be felt in connecting rods (the upper end of connecting rods may have as much as $\frac{3}{16}$ inch side shake), the lower bearing should be refitted. If the roller races in the lower end of the connecting rods are not too badly worn, they can be lapped to smooth and round them up; then new crank pin and oversize roller bearings can be fitted to the correct clearance. If roller races are so badly worn or damaged that they cannot be cleaned so that correct clearance can be obtained with oversize rollers, new connecting rods or ones that have been rebushed by the manufacturer should be used.

b. Bronze piston pin bushings (in the upper end of connecting rods) can be replaced, if necessary, when new piston pins are fitted.

c. When a connecting rod is badly bent, twisted, cracked, or otherwise not suitable for further dependable service, it should be renewed.

d. Check the alinement of connecting rods (by means of the squaring plate at the piston skirt) before the cylinders are put on the engine.

12. Timing gears.—Timing gears require very little attention. If they become noisy, it may be desirable to replace them when the engine is overhauled. Loose and exceptionally noisy bushings must be promptly replaced to avoid damage to the crankcase. Gear teeth are usually marked for correct timing positions.

13. Carburetion.—*a.* Some carburetors on motorcycles have both an idling and a high speed jet adjustment. Others have an idling jet adjustment only, the high speed jet being fixed (not adjustable). Experience has shown that when drivers do their own adjusting, an

abnormally high percentage of carburetors are usually out of adjustment. Carburetors should be adjusted only by a skilled motorcycle mechanic. See "Operating Instructions" supplied with the machine for the correct method of adjusting carburetors.

b. The carburetor (fig. 7) should be inspected and cleaned approximately every 1,000 miles; especially under adverse operating conditions. The fuel strainer and line should be cleaned at the same time. The most common carburetor trouble, besides improper adjustment, is water and dirt in the float bowl. Some late model motorcycles have

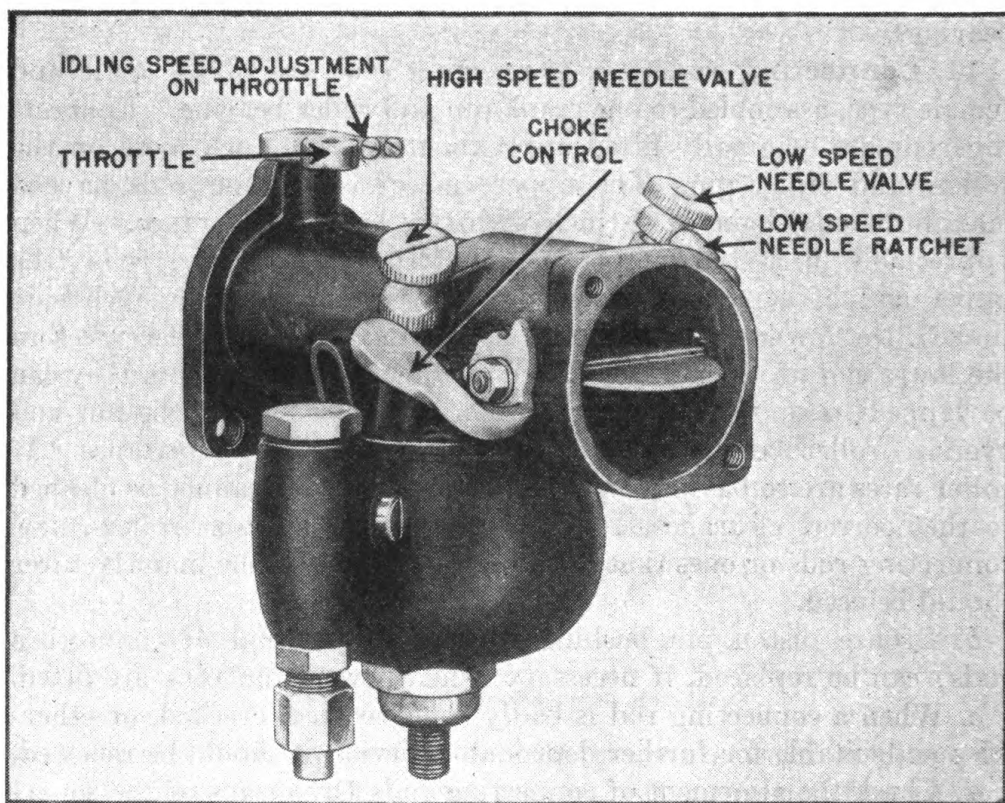


FIGURE 7.—Motorcycle carburetor.

a drain plug in the bottom of the bowl to facilitate frequent draining and flushing, which is usually sufficient cleaning.

c. The gasoline tank seldom requires cleaning, unless water gets into it. If it does, remove the tank from the vehicle, empty, clean, and dry it thoroughly before replacing it.

d. The air cleaner requires considerable attention. When operating over good roads and normal conditions, it is necessary to wash the filter element thoroughly with gasoline (*outdoors*) every 500 miles and then saturate it with heavy motor oil. The saturated element

cleans the dirt and dust from the air before it reaches the carburetor and prevents excessive internal engine wear.

(1) When motorcycles are operated over dusty, sandy, or similar terrain the air filter should be checked and cleaned oftener—approximately every 100 miles of operation or at least once every day.

(2) Air cleaners of the oil bath type should be cleaned and refilled after each 10 to 12 hours of operation when operating the vehicle over dusty or sandy terrain. During normal operation on hard-surfaced roads they should be cleaned and refilled monthly or every 1,000 miles, and inspected weekly for correct oil level or excessive accumulation of dust and dirt. The screening element should be cleaned and saturated with engine oil. The oil container should be removed by loosening the lower clamp and thoroughly cleaned. Refill it to the tip of the cone in the center of the container with the grade of oil being used in the engine and reassemble it to the cleaner body. Care should be taken not to add excess oil as this will restrict the air flow, and oil will be pulled into the cylinders, causing excessive carbon and foul spark plugs.

14. Lighting and battery ignition system.—The motorcycle electrical system does not differ greatly from that of other motor vehicles except in the size of units. However, the hard service to which motorcycle is subjected makes it necessary to check the electrical system frequently for loose connections, broken wires, and cracked or worn wire insulation.

a. Generator.—The generator should be checked and cleaned every 1,000 miles or oftener under adverse operating conditions. The armature and commutator should be cleaned, the brush springs should be replaced if they are weak, and new brushes installed. It is cheaper to replace brushes frequently than to buy new armatures or replace those which have been “burned” or “shorted out” by worn brushes. Serious damage can be done to the generator, relay switch, and other electrical units when the battery becomes accidentally disconnected from the charging circuit. The commutator end bearings should be lubricated in accordance with the manufacturer’s recommendations.

b. Battery.—The level of the water in the battery ($\frac{1}{4}$ inch to $\frac{3}{8}$ inch above plates) must be checked each week because of its small capacity and the heat and hard service to which it is subjected. Drivers should report on trip tickets all occasions when their machines have fallen, spilling the battery electrolyte. Lost electrolyte should be promptly replaced, and any electrolyte spilled on the motorcycle should be neutralized with a solution of baking soda and water.

c. Condenser.—The condenser is not likely to fail or give any trouble. Hard starting, missing, and abnormal burning and pitting of the circuit breaker points possibly indicate a faulty condenser. However, the latter conditions may be due to excessively high generator charging rate or to faulty wiring connection which causes the electrical system to build up abnormally high voltage.

d. Coils.—Coils usually cause little trouble on motorcycles and require infrequent replacement.

e. Spark plugs.—(1) Spark plugs should be inspected and, if dirty or glazed, cleaned (with a sand-blast cleaner), and the gaps reset about every 500 miles. The life of a spark plug is shorter on an air-cooled engine than on a water-cooled engine. Overheating caused by a defective oiling system or lean carburetor adjustment will materially shorten the life of spark plugs. Use plugs of a rating specified by the vehicle manufacturer.

(2) The "waste spark" method of ignition is used on some motorcycles equipped with battery ignition. Both plugs fire each time the breaker points open; one spark fires the compressed charge in the cylinder while the other is wasted.

f. Timing and breaker points.—The timing and condition of the breaker points should be checked monthly or every 1,000 miles by a qualified motorcycle mechanic. The fiber on the breaker arm often wears down in hard service and retards the timing; this, in turn, causes the engine to overheat and operate sluggishly. Breaker points should be filed and the gap readjusted when inspection shows they are burned or pitted.

15. Engine cooling.—*a.* It is very important that the exposed cylinder fins of an air-cooled engine be kept free of dirt, heavy paint, or similar insulating substances. Heavy paint, being a poor conductor of heat, should not be used on the outside of a motorcycle (air-cooled) engine. Anything that reduces the ability of the engine to transmit heat into the atmosphere or that affects the air stream around the engine raises the operating temperature of the engine. A special cylinder paint sold by the motorcycle manufacturers does not materially affect engine cooling.

b. Motorcycle engines must not be allowed to operate while the motorcycle is stationary because the cooling of the engine depends essentially upon the air stream created by movement of the vehicle.

16. Oiling system.—Modern motorcycles use a pump to circulate lubricating oil to the various parts of the engine and a scavenger pump to return the oil to the tank. All riders should study the de-

scription of the oiling system given in the manufacturer's operation manual.

17. Transmission.—*a.* Troubles attributed to the transmission are almost invariably the result of improper clutch adjustment, improper operation of the clutch, or improper shifting of the gears by the rider. Gear box, gears, and shifter clutches are frequently damaged or broken because of one of these bad practices.

b. The transmission uses the same grade of oil as the engine. The oil level in a motorcycle transmission should be checked frequently. The filler-plug opening is the correct oil level, with machine standing straight up on a level surface. The rough service suffered by the transmission makes it leak more quickly than other motor-vehicle transmissions. Low oil level will roughen gear teeth, make them noisy, and may also damage bearings.

18. Chains.—*a. Front chain.*—The front chain will last as long as the machine if it is properly adjusted and lubricated. It is lubricated directly by the pressure oil pump in some machines and runs in an oil bath in others. Lubrication of the front chain should be checked occasionally.

b. Rear chain.—The average life of the rear chain is between 5,000 and 10,000 miles on average highways. Chain life will be reduced considerably if the machine is used mostly on dirt, gravel, or sandy roads. If the chain is not properly adjusted and lubricated, these mileages will be much less. A loose rear chain has a short life, due to constant jerk and whip; a tight one will "freeze" on its pins and rollers and possibly break. Occasionally the rear chain should be thoroughly cleaned and washed to remove grit, dirt, and gummy grease, and relubricated in accordance with the manufacturer's recommendations.

19. Wheels.—If one spoke of a wheel becomes loose and is not tightened, the wheel in time may be destroyed. The wheels should be checked carefully for loose spokes and "tuned-up" every 6,000 miles by motorcycle mechanics. In addition, the driver should frequently check for loose spokes. No adjustment can be made on the roller-type wheel bearing except to reduce end play in the wheel by inserting shims. If carefully maintained, the life of this type bearing is about 20,000 miles. When bearings are replaced they must be oversize. (Some motorcycles may have adjustable ball bearings on one or both wheels.) The tapered roller bearings found on other models are adjustable and are usually good for the life of the machine.

20. Brakes.—*a.* Modern motorcycles have brakes on both the front and rear wheels. The side-car wheel has a brake which is

operated by the rear-wheel brake pedal. The front brake is hand operated; the rear and side-car brakes are foot operated. Besides being used in regular service, the front-wheel brake can also be used as an emergency brake, for holding the machine on a grade while the vehicle is stopped, or while cranking the engine.

b. Motorcycle brakes should be kept free from dirt and grease at all times and properly adjusted. These brakes must be adjusted more frequently than automobile brakes. They must be applied carefully, especially the front one. If it is applied too suddenly and too hard, it may lock the wheel and seriously hurt the driver by making him lose control of the motorcycle.

21. Front fork.—Front forks should be inspected for rebushing about every 6,000 miles. Head bearings should be inspected for looseness at every monthly or 1,000-mile inspection. If the bearings are too loose, the front end of the machine will wobble. If too tight, they will bind and steering will be hard. In either case, head-bearing cones and cups will become pitted and damaged.

22. Frame.—Frames, forks, and handlebars, if not too badly bent, can be straightened cold; heat should not be used. As a rule, a strong press is necessary for straightening these parts.

23. Muffler.—A clogged muffler causes back pressure, overheating, and sluggish engine performance. Mufflers should be kept clean and free from mud and road dirt.

SECTION III

OPERATIONS

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24. Cold weather operation.—The following preparations and precautions are necessary for operating motorcycles in cold weather:

a. Transmission lubrication.—The same grade of oil is used in the engine and transmission of most motorcycles. The viscosity of oil used in winter should be lower than that used in summer. If temperature is so low that oil congeals in the gear box and causes hard shifting, a little kerosene (not to exceed 10 percent) can be added to thin the oil.

b. Battery.—(1) The battery should be removed and fully charged.
(2) The general condition of the battery should be tested at the time of charging.

(3) Terminals should be cleaned and tightened.

(4) Generator charging rate should be increased.

(5) Water should be added to the battery before it is charged to insure circulation of electrolyte.

c. Spark plugs.—Spark plugs should be cleaned and the gaps checked or new plugs installed.

d. Carburetor.—The carburetor should be cleaned and adjusted. The idling speed adjustment should be set so that the engine will idle fairly fast with the throttle closed. Also remove and clean the fuel strainer.

e. Distributor.—Breaker points should be filed and adjusted or renewed.

f. Oil.—Oil should be of the grade prescribed by the manufacturer according to Navy symbol numbers. It must be changed (more often in cold weather) because of increased crankcase dilution, condensation, and sludge formation.

g. Valves.—Sticky and sluggish valves will cause hard starting. To remedy this, raise the valve covers and, with the engine hot, race the motor and pour a little kerosene or other solvent around the valve springs and stems.

25. Breaking-in procedure.—*a.* (1) For the first 100 miles avoid long, steep hills, and run at speeds between 20 and 35 miles per hour. Do not exceed 40 miles an hour even in spurts or when passing another vehicle.

(2) During the next 400 miles ride at speeds up to 40 miles per hour.

(3) Do not run a tricycle or a machine with a side car faster than 45 miles per hour, or a solo motorcycle faster than 50 miles per hour for the next 500 miles.

b. At the end of 500 miles, and again at 1,000 miles, the machine should be given a thorough inspection. Give special attention to tightening the cylinder-head bolts, cylinder base and manifold nuts, and to the proper adjustment of the valve lifters and the drive chains. Check lubrication of the front chain. Check transmission mounting bolts and nuts. Also check entire machine for loose bolts, nuts, etc.

c. When the engine has been properly broken in, after 1,000 miles of operation, it can be run at higher speeds. The machine must accelerate quickly after it has been operated 1,000 miles, checked, and properly adjusted. If it does not, it is stiff and the breaking-in period should be lengthened.

d. In rare instances it is possible that some new machines are still not properly “run-in” to produce to their fullest capacity. It is advisable to continue treating such motorcycles on the basis of the above breaking-in procedure until all indications of tight and new fits have been worked out of the vehicle and the danger of damage, especially

to the engine, cylinders, pistons and rings, bearings, and other parts, has been eliminated.

e. In breaking-in an engine on the stand after overhaul, or if for any other reason the engine is allowed to idle for more than a very short time, a large electric fan should be placed on each side of the engine to cool it. An air-cooled engine is cooled by forced streams of air passing over the cylinder fins. If a motorcycle engine is not cooled by a forced air stream, it may burn out.

SECTION IV

INSPECTIONS

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26. General.—*a.* Systematic and periodic inspections of the motorcycle are necessary to determine the serviceability of the vehicle and whether it is being properly used, serviced, and repaired. In this respect the motorcycle is not unlike any other motor vehicle and can be inspected in much the same manner.

b. The inspections of motorcycles are classified as—
 Command.
 Maintenance.
 Technical.

27. Command.—*a.* Command inspections are, as the name implies, a function of command. Commanders should make inspections of their motorcycles at the time they inspect other motorized equipment.

b. In addition to making a visual inspection for cleanliness and appearance, higher commanders should inquire about the adequacy of numbers and types of motorcycles, motorcycle maintenance and operating personnel, supplies and equipment, and the economic assignment, pooling, and use of motorcycles.

28. Maintenance.—*a.* Maintenance inspections are preventive in nature and as such are the responsibility of commanders of operating organizations. They should be a part of scheduled maintenance operations. They indicate the nature of maintenance operations if made before or during these operations and check the manner and completeness in which maintenance operations are performed.

b. Daily inspections are normally made by the rider. The following list will serve as a guide:

(1) Check gasoline and oil supply.

(2) Check wheels for loose spokes and tires for correct inflation, bruises, and other defects.

(3) Check for loose bolts and parts.

(4) Clean cooling surface of engine. When this work is done indoors (shop or garage), use a wire brush and a chemical cleaning compound or some form of solvent. Gasoline, diluted with kerosene, may be used outdoors as a cleaning agent, but the fire hazard and explosive nature of vaporized gasoline must be guarded against at all times.

(5) Test fork for looseness.

(6) Check brakes and clutch linkage.

(7) Check operation of all controls.

(8) Check lights, horn, and instruments.

(9) Check air cleaner for dust, dirt, etc.

c. In addition to the above the rider should perform the following checks and operations weekly:

(1) Check motorcycle for loose bolts and nuts.

(2) Check electrical system for loose wires.

(3) Add oil to transmission if needed. Some oil will continually seep out.

(4) Add distilled water to battery, if needed, just before driving; cover plates with $\frac{1}{4}$ inch to $\frac{3}{8}$ inch of water.

(5) Grease or oil bearings requiring periodic lubrication as shown on lubrication chart. Do this oftener than once a week if weekly driving totals over 500 miles.

(6) Clean and lubricate rear chain.

(7) Check driving chains for adjustment.

d. Monthly or every 1,000 miles the following points should be checked by the chief of section and any corrections or adjustments made by a qualified motorcycle mechanic:

GUIDE FOR MONTHLY OR 1,000-MILE MAINTENANCE INSPECTIONS

a. In making the inspection of the vehicle the inspector should verify that the part—

(1) Is on the vehicle and properly secured.

(2) Is worn or damaged.

(3) Is clean.

(4) Appears to be working correctly.

(5) Is properly lubricated.

b. When time does not permit a complete inspection, cover the more important (starred (*)) points:

(1) Front mudguard.

(2) Handlebars.

* (3) Headlight.

- * (4) Steering head bearings.
 - (a) There should be no appreciable play or shake and no drag in head bearings.
 - (b) Does wiring show signs of worn insulation or broken strands?
- * (5) Front wheel.
 - (a) Shake handlebars to see if front wheel is loose.
 - (b) Check and tighten loose spokes.
- (6) Instrument panel.
- (7) Horn.
- (8) Tank.
- * (9) Oil level in tank and crankcase.
- * (10) Engine.
 - (a) Are cooling fins and engine clean and free from paint?
 - (b) Are valve tappets free and properly adjusted?
 - (c) Drain oil from oil tank and sump. If drained oil is gritty or dirty, use a very light engine oil (SAE 10—Navy symbol No. 2310) as a flushing oil. When oil circulating system has been cleaned out, refill with new, specified engine oil.
- * (11) Carburetor.
 - (a) Is carburetor securely assembled to engine?
 - (b) Is gasoline strainer clean and free from sediment?
 - (c) Is air cleaner functioning properly and is filter element clean and moist with oil?
 - (d) If oil bath type, is oil level correct?
- * (12) Ignition.
 - (a) Are circuit breaker points clean and properly adjusted?
 - (b) Are spark plugs clean and points properly adjusted?
- (13) Battery.
 - (a) Are terminals clean?
 - (b) Is electrolyte at proper level ($\frac{1}{4}$ inch to $\frac{3}{8}$ inch above plates)?
 - (c) Is there any indication of a cracked battery case?
- (14) Battery cables.
- (15) Saddle.
- (16) Footboards.
- (17) Jiffy stand.
- (18) Stand.
- * (19) Rear chain.
 - (a) Does it have the proper amount of slack?
 - (b) Is it clean?
 - (c) Is it lubricated?
 - (d) There should be about $\frac{1}{2}$ -inch free movement of chain up and down midway between sprockets.
- (20) Rear mudguard.
- * (21) Taillight.
- (22) License plate and bracket.
- (23) Crash bars.
 - Are they in place and secure?
- Start engine, rear wheel off the ground.*
- (24) Kick starter.
 - Did driver have any difficulty in starting engine?

- (25) Spark.
 (a) Does spark control grip turn to give full range to spark lever?
 (b) Does engine respond?
 (c) Is engine properly timed?
- (26) Throttle.
 Does throttle control grip turn to give full throttle opening?
- (27) Clutch.
 (a) Does clutch engage and disengage when pedal is operated?
 (b) Is there indication of slipping or dragging?
- (28) Transmission.
 Can driver shift smoothly through different speeds?
- (29) Ammeter.
- *(30) Oiling system.
- *(31) Brakes.
 (a) Do they function properly?
 (b) Spin wheels when brakes are released to see if they drag.
 (c) Rear brake should not take effect until foot pedal is pushed downward about 1 inch.
 (d) Hand brake lever for front brake should move about a quarter of its full movement before brake starts to take effect.
- (32) Tail pipe and muffler.
 Is tail pipe clogged or dented so that it will cause excessive exhaust back pressure?
- (33) Ride vehicle.
 (c) Check all controls and steering.
 (b) Does lack of speed and performance indicate need of valve grinding or engine overhaul?

29. Technical.—Technical inspections of motorcycles should be made every 6 months or 6,000 miles by technically qualified enlisted personnel under technically qualified commissioned personnel. These are a follow-up and check on maintenance inspections and operations and are used to determine whether the motorcycle should be continued in service or overhauled. The following may be used as a general guide in making technical inspections of motorcycles:

TECHNICAL INSPECTION

Date_____

Organization_____Station_____ ☐ Mark—O. K.
 USA registration No._____ ☐ X Mark—Deficient
 Make and type_____

Serial No._____

Engine No._____

Speedometer reading_____

a. The inspector should check each part in detail, applying the following questions:

- (1) Is it clean?
- (2) Is it correctly secured and adjusted?
- (3) Is it serviceable?
- (4) Is it correctly lubricated; is lubricant leaking?

- (5) Is it working correctly?
 (6) Is it sprung, bent, warped, or dented?
 b. Check vehicle tool-kit equipment.

	Check	Remarks
FRONT OF VEHICLE		
<i>Remove front wheel.</i>		
(1) Front wheel and bearings.		
(a) Are bearings in good condition?.....		
(b) Is wheel bent or warped or spokes bent or broken?.....		
(c) Are spokes tight?.....		
(d) Is axle worn?.....		
(e) Is brake lining or brake drum worn?.....		
(f) Clean bearings; pack with new lubricant.		
(2) Front tire.		
(a) Do tires need replacing?.....		
(b) Are tires properly mounted with balance dot to valve stem?.....		
(c) Have tires bad bruises, cuts, or tears?.....		
(d) Is there excessive wear due to wheel being out of line?.....		
(e) Is valve stem cap on?.....		
(3) Front fork.....		
(4) Front springs.....		
(5) Front springs and bearings (or front springs, rods, and bushings).		
(6) Front fender and brackets.....		
(7) Right and left bell cranks and bearings.....		
<i>Mount front wheel.</i>		
(8) (a) Check bearing adjustment.....		
(b) Is bearing on brake drum side over-lubricated?.....		
(c) Are axle nuts tight and properly secured?.....		
(d) Does front wheel run true on axle?.....		
(9) Front wheel brake.		
(a) Are brake anchor links secure and properly lubricated?.....		
(b) Is brake properly adjusted?.....		
(c) Do brake control handle and linkage work properly?.....		

	Check	Remarks
FRONT OF VEHICLE—continued		
(10) Headlight and bracket.....	-----	
(11) Steering head, bearings, and steering head lock.	-----	
(12) Handlebars and grips.....	-----	
(13) Horn and bracket.....	-----	
(14) Rear vision mirror.....	-----	
(15) Instrument panel.....	-----	
LEFT SIDE OF VEHICLE		
(16) Left side members of frame.....	-----	
(17) Left tank.....	-----	
(18) Speedometer and speedometer cable.....	-----	
(19) Left foot board.....	-----	
(20) Clutch pedal and rod.....	-----	
(21) Clutch lever and clutch adjustment.....	-----	
(22) Primary drive case.....	-----	
(23) Primary drive chains (or gears).....	-----	
(24) Generator drive belt guard (if any).....	-----	
(25) Seat and seat springs.....	-----	
(26) Tool box.....	-----	
(27) Jiffy stand.....	-----	
(28) Safety guard.....	-----	

	Check	Remarks
REAR OF VEHICLE		
(29) Rear fender and brackets		
(30) Taillight and brackets		
(31) Rear stand and holder		
<i>Remove rear wheel.</i>		
(32) Rear wheel and bearings.		
(a) Are bearings in good condition?		
(b) Is wheel bent or warped or are spokes bent or broken?		
(c) Are spokes tight?		
(d) Is axle worn?		
(e) Are brake lining and brake drum worn?		
(f) Is bearing on brake drum side over-lubricated?		
<i>Mount rear wheel.</i>		
(g) Check bearing adjustment		
(h) Are axle nuts tight and properly secured?		
(i) Does rear wheel run true on axle?		
(33) Rear tire.		
(a) Does tire need replacing?		
(b) Is tire properly mounted with balance dot to valve stem?		
(c) Has tire bad bruises, cuts, or tears?		
(d) Is there excessive wear due to wheel being out of line?		
(e) Is valve stem cap on?		
(34) Rear wheel drive sprocket		
(35) Rear wheel brake.		
(a) Is brake properly adjusted?		
(b) Does brake control and linkage work properly?		
(36) Speedometer drive		

	Check	Remarks
RIGHT (LEFT) SIDE OF VEHICLE		
(37) Right side members of frame.....	-----	
(38) Muffler.....	-----	
(39) Secondary drive chain and chain adjustment.	-----	
(40) Secondary drive chain guard.....	-----	
(41) Transmission case. (a) Is lubricant in transmission and clutch at correct level? (b) Are there indications of leaks?.....	----- ----- -----	
(42) Rear brake pedal and linkage.....	-----	
(43) Right footboard.....	-----	
(44) Right tank.....	-----	
(45) Oil level in oil tank.....	-----	
(46) Starting crank.....	-----	
(47) Gear shift lever. Are controls properly adjusted?.....	----- -----	
SIDE CAR		
(48) Frame. (a) Is it properly secured to motorcycle?..... (b) Is it in correct alinement?.....	----- ----- -----	
(49) Body. (a) Is exterior free from dents?..... (b) Is it properly secured to springs?..... (c) Is interior clean?..... (d) Is upholstery clean and free from tears? (e) Is canvas cover clean and free from tears?.....	----- ----- ----- ----- ----- -----	
(50) Springs.....	-----	
(51) Fender.....	-----	

	Check	Remarks
SIDE CAR—continued		
<i>Remove side car wheel.</i>		
(52) Wheel and bearings.		
(a) Are bearings in good condition?		
(b) Is wheel bent or warped, or are spokes bent or broken?		
(c) Are spokes tight?		
(d) Is axle worn?		
(e) Is brake lining or brake drum worn?		
(f) Is brake free of grease?		
<i>Mount side car wheel.</i>		
(a) Check bearing		
(b) Are axle nuts tight and properly secured?		
(c) Does side car wheel run true on axle?		
(53) Side car brake.		
(a) Is brake properly adjusted?		
(b) Do brake control and linkage work properly?		
(54) Spare tire and carrier		
ENGINE		
(55) Engine mounting bolts		
(56) Cylinder head bolts		
(57) Magneto		
(58) Spark advance and retard control		
(59) Carburetor gaskets and bolts		
(60) Fuel lines and connections		
(61) Battery carrier		
(62) Battery and battery terminals and cables		
(63) Generator and generator mounting		
(64) Generator drive adjustment (if belt driven)		

	Check	Remarks
ENGINE—continued		
(65) Generator brushes and brush leads.....	-----	
(66) Spark plug and cables.....	-----	
(67) Oil pump.....	-----	
(68) Oil lines and connections.....	-----	
(69) Timing gear case.....	-----	
(70) Valve clearance and springs.....	-----	
(71) Dust covers.....	-----	
(72) Breaker points (battery ignition).....	-----	
(73) Condenser (battery ignition).....	-----	
(74) Coil (battery ignition).....	-----	
(75) Ignition switch.....	-----	
(76) Air cleaner and gasoline strainer.....	-----	
<i>Start engine.</i>		
(77) Inlet and exhaust manifolds.....	-----	
(78) Cylinder head bolts.....	-----	
(79) Cylinder base nuts.....	-----	
(80) Crankcase.....	-----	
(81) Carburetor adjustment (preliminary) (make final road test after repairs and adjustments).	-----	
(82) Steering action. Does it steer easily straight ahead and in full traverse in either direction without wandering or weaving or steering to one side?	-----	
(83) Clutch action. Does clutch operate freely without grab- bing, dragging, or slipping?	-----	

	Check	Remarks
ENGINE—continued		
(84) Transmission action.		
(a) Do gears shift easily and freely in all speeds?	-----	
(b) After meshing gears does movement of gear shift lever show excessive wear?	-----	
(c) Is there excessive transmission noise indicating wear?	-----	
(85) Are brakes properly adjusted and do they operate without grabbing or dragging?	-----	
(86) Engine performance.		
(a) Does engine idle smoothly?	-----	
(b) Does it accelerate without faltering?	-----	
(c) Does it indicate loss of power or does it knock under load?	-----	
(87) Recheck carburetor adjustment (and make final adjustment)	-----	
(88) Oil pressure	-----	
(89) Charging rate (for proper charging rate) ..	-----	
(90) Speedometer action (reading). Check on measured course	-----	
(91) Headlight, taillight, instrument, and speedometer lights and horn (functioning).	-----	

Remarks: General condition of vehicle.

(1) Lubrication ¹

(2) Cleanliness ¹

(3) Serviceability ²

Work order made out

(Signature of inspector)

¹ Rate these items—E, excellent; G, good; P, poor.

² Rate should be based on mechanical condition and general appearance. (See Cir. 1-10, OQMG, Dec. 1939.)

THE MOTORCYCLE

SECTION V

TRAINING COURSE FOR MOTORCYCLE DRIVERS

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30. Training course.—*a.* This outline, intended to help an instructor conduct a course of training, is based upon approximately a 50-hour course of instruction with periods of 2 or 3 hours per day.

b. During each period, about 45 minutes should be spent in explaining details of operation and the care and adjustment of various units—with demonstrations where necessary. The remainder of the time should be spent teaching students to ride, allowing them to practice on the road, and having them make various adjustments and repairs. Instruction in “rules of the road,” traffic laws, and Army orders and regulations for the operation of motorcycles should be included in that part of the period devoted to riding. Classes should be limited to the number of motorcycles available for instructional purposes. Each motorcycle should be fully equipped with a complete tool kit, hand-operated grease gun, tire repair kit, and tire pump. Each student should be supplied with a copy of the manufacturer’s handbook applicable to the specific machine issued to him.

c. This course is not intended to make mechanics out of students. During instruction it should be constantly stressed that the driver must not tinker with the machine. Mechanical work and major adjustments must be done by experienced mechanics. The mechanical instruction is included in the course so that the driver will be able to service and

maintain his vehicle more intelligently, and so that, when in trouble on the road, he can make minor emergency repairs and bring his motorcycle back to the garage.

d. The students should be required to check bolts and nuts frequently to make sure that they are tight. They should be warned against spilling gasoline on the machines when filling tanks. If gasoline is spilled on a very hot engine, or if the engine backfires when starting, there is danger of fire.

e. Students should be given a study assignment in the manufacturer's handbook for each instruction period.

f. It may be found advisable to give riders who have difficulty in maintaining their balance on a motorcycle early driving instructions on machines equipped with side cars. However, students should ride bicycles to develop balance. Instructors may ride in the side cars and explain how the controls should be handled. Instruction on a solo motorcycle should begin as early as possible.

31. Origin of schedule.—The detailed schedule given in the paragraphs that follow is similar to the one recommended to police departments by the Harley-Davidson Motor Company and the Indian Motorcycle Company.

32. First period.—The instructor should explain and demonstrate the various controls and have the students become familiar with them before they attempt to ride.

a. Throttle control.—Demonstrate turning throttle control grip to show how throttle is opened and closed. Explain that throttle is closed with grip turned all the way out. With all adjustments correct, a warm engine will idle.

b. Spark control.—Demonstrate turning spark control grip to show how spark is advanced and retarded. Explain that spark is advanced with grip turned all the way in and retarded with grip turned all the way out. Explain that spark should be fully advanced under normal running conditions and should be retarded somewhat only when idling the engine; when laboring under a hard pull; when knocking; and when starting, if the engine is inclined to backfire.

c. Clutch control.—Demonstrate clutch control with machine in gear and mounted on rear stand. Operate clutch pedal and have student note engagement and disengagement of clutch. Explain that clutch must be fully engaged when cranking engine; and that clutch must be fully disengaged when shifting gears.

d. Rear brake.—Show how rear brake is applied by means of foot pedal at right footboard.

e. Front brake.—Show how front brake is applied by means of hand lever on left handlebar.

f. Cranking.—Explain and demonstrate correct method of cranking engine. It should be cranked with ignition switch off until either piston is coming up against compression. Then, turn switch on and use weight rather than leg muscles to give starter a vigorous kick.

g. Gear shift lever.—Explain purpose of gear shift lever and location of lever for different gears (low, neutral, second, high; also, reverse on tricycles). Students must learn to shift gears without looking down at lever. Looking down is both dangerous and unnecessary. Some models have a shifter guide on tank with gear positions marked; others have no guide.

h. Ignition switch.—Explain which switch is used for ignition, and importance of turning switch to off position whenever rider stops engine.

i. Ammeter.—Explain that due to open breaker-gap circuit the ammeter does not always show discharge when ignition switch is turned to on position. Late model Harley-Davidson motorcycles are not equipped with an ammeter but use a signal light to indicate generator charging.

j. Carburetor choke lever.—Explain use of choke lever. In closed position choke allows a large proportion of fuel and very little air to enter engine. After engine is warm, lever should be set in running position to avoid crankcase dilution and to allow engine to fire evenly.

k. Use of controls.—Explain and demonstrate proper method of starting and stopping engine, shifting gears, and handling other controls.

l. Application by students.—Spend remainder of instruction period having students practice starting and stopping engine, shifting gears, applying brakes, and handling clutch and other controls with motorcycles mounted on rear stands.

33. Second period.—*a. Racing engine.*—Explain harmful effects of racing engine and caution students against this practice. This is particularly harmful when engine is cold. Without a load and with throttle open (racing engine), revolutions per minute go far above normal. This may seriously damage engine.

b. Flooded engine.—Explain and demonstrate how to start an engine that has become flooded by overchoking. The engine should be cranked several times with throttle wide open to draw in necessary air to overcome flooded condition and to make mixture readily

combustible. Then turn ignition switch on and start engine in usual manner.

c. Oil.—Impress upon students necessity of keeping plenty of oil in tank and/or sump. If allowed to run dry, engine may be seriously damaged.

d. Practice.—(1) Students should practice starting and stopping engine, shifting gears, and handling controls. As they gain confidence they should be permitted to practice riding machines on road or on practice field.

(2) If some of the students have ridden before, they will require less practice and can help the other students. The throttle of each machine should be set so that the machine cannot exceed 25 miles per hour.

(3) The course over which the students are to ride does not necessarily have to be a long one. There should be an experienced driver stationed at each end of the course to coach the students and help them get under way. Students should keep the machine in low gear until they have gained confidence enough to use a higher gear.

(4) In starting off the first few times, the instructor should run alongside and hold the motorcycle upright for a short distance until the driver gets his balance. As the student approaches the end of the course, he should be assisted in turning around. He should not attempt to make a turn until he has sufficient confidence.

(5) It should be borne in mind that when the inexperienced driver goes through the initial training period without a fall to bruise him or to shake his nerve he gets along much better and has more confidence in himself and learns more rapidly.

34. Third period.—*a. Operating new engine.*—Explain that a new engine should not be driven for long distances in low or second gear or at high speeds (usually not over 35 miles per hour during the first 500 miles or more) because pistons, rings, and various bearings are somewhat tight. They can become overheated and damaged by driving the new machine at a high rate of speed. After a motorcycle has been driven 500 to 1,000 miles, parts are loosened up and their surfaces become burnished, allowing it to be driven at a higher rate of speed without fear of damage as long as it is properly lubricated. No machine should be driven at or near its maximum top speed until after it has been properly broken in.

b. Cleaning.—Explain importance of keeping a motorcycle clean and also how to clean it. Explain provisions of existing regulations that prohibit use of gasoline as a cleaning agent in shops and garages; also detail fire hazards incident to use of a volatile inflammable liquid

such as gasoline. A noninflammable solvent or proper chemical cleaner is safer to use and more desirable. While gasoline can be used in the open for cleaning purposes, its hazards must be well known; it should not be used on painted or enameled surfaces. A mild, noncaustic soap may be used for washing painted surfaces, but all traces of soap should be removed with clear water.

c. Riding.—Students should spend the greater part of the remainder of this period practicing riding. A short time at the end of the period should be spent cleaning the motorcycles.

35. Fourth period.—*a. Lubrication.*—(1) Explain importance of correct lubrication. Pistons may seize, and thus serious damage to the engine may result if lubrication is insufficient or if an incorrect grade of oil is used. The oils recommended by the manufacturer should be used.

(2) It is necessary to drain and flush the oil circulating system of motorcycles at least every 1,000 miles or monthly. The need for oil change is based on oil contamination due to its use for relatively long periods of time, or due to foreign and gritty substances in the old oil, or because of the frequent use of carburetor choke the oil has been excessively diluted.

b. Riding.—Students should spend the remainder of this instruction period practicing riding.

36. Fifth period.—*a. Daily care.*—Explain daily care of motorcycle and use of lubricating equipment and fittings.

(1) Inspect motorcycle carefully after day's run and make necessary minor adjustments and repairs.

(2) Inspect tires to make sure that no nails or other pointed objects have been picked up. Look for cuts in tread. It is dangerous to ride with leaky, defective, or unbalanced tires, especially at high speeds.

(3) See that brakes are properly adjusted. Spin wheels to make sure that brakes are not too tight.

(4) Check lights to be sure that they are in good working order.

(5) Check adjustment of both chains.

(6) (a) Oil and grease machine according to mileage covered as directed by manufacturer's lubrication chart.

(b) Fill gasoline tank.

(7) Engine-support bolts should be checked and tightened daily if necessary. If missing, they should be replaced. Loose or missing engine-support bolts cause twisting and distortion that can result in broken casting and if neglected for some time can cause serious injury to the vehicle and its operator.

b. Lubrication.—(1) Demonstrate how to fill grease pressure gun and then (using lubrication chart as a guide) lubricate each point having a lubrication fitting, naming each point as it is greased.

(2) Explain and demonstrate oiling points not having grease fittings, such as handlebar controls, brake-rod clevis, clutch-rod clevis, and other points.

c. Riding.—Let riding practice occupy most of this period, and at the end have students give machines the required daily attention, except those points that should be checked prior to starting.

37. Sixth period.—*a. Valves.*—(1) Explain why poorly seated valves, sluggish-acting (sticking) valves, and broken valve springs cause loss of power, hard starting, misfiring, and sometimes “hitting on one cylinder.” Show that unless valves are seated properly, a portion of the compressed fuel-air mixture will leak out and cause power losses. Sticky valves cause a cold engine to start hard, misfire, and run on one cylinder until it has warmed up, when it will run fairly well on both cylinders. With a broken valve spring, the engine may run reasonably well at low speed, while at high speed the affected cylinder may misfire or stop firing entirely.

(2) (*a*) Demonstrate proper method of adjusting valves. Be sure that a valve is fully closed when adjusting its tappet clearance (crank engine until corresponding valve in opposite cylinder is held wide open). Students should be warned that valve tappet adjustment must be done by an experienced mechanic. Each student, however, should be taught the correct method of making the adjustment.

(*b*) Since it is very easy to adjust tappets improperly, it is well to have each man adjust tappets in only one of the training machines set aside for that purpose. The adjustments made by each man should be carefully checked.

b. Riding.—Students should spend the remainder of this instruction period practicing riding. If by this time any of the students have not grasped the knack of handling their machines, they should be given extra attention or perhaps dropped as inept.

38. Seventh period.—*a. Spark plug.*—(1) Explain function of a spark plug, and why and when they should be replaced. Many spark plugs of apparent good quality are not suitable for motorcycle service and will give trouble by fouling at low speed or causing preignition at high speed. It is best to use replacement plugs of the type with which a motorcycle was originally equipped. An engine may be seriously damaged in a short time through overheating caused by plugs that are not designed for motorcycle engines.

(2) Explain why a spark plug with cracked porcelain may cause a misfire.

(3) Explain that fouled plugs can usually be reconditioned by a thorough cleaning. It is not advisable to take plugs apart when cleaning them because they may leak around the core gasket if improperly reassembled. Plugs should preferably be cleaned with a sandblast cleaner or scraped by hand.

(4) In order to impress upon the students the importance of having spark plug points correctly adjusted, start an engine in which the points are correctly adjusted and have students note the even firing when the engine is running slowly. Next, remove the spark plugs and adjust the points so that they are too close together; then with engine running slowly, have students note the change in firing rhythm.

(5) Students should be taught how to check and correct spark plug gaps with tools available to them, as an emergency expedient.

(6) Students should be instructed with reference to the possible effect of operating the motorcycle engine with the spark too far advanced, and that this can cause breaking of piston rings, breaking of kick starter pedal, and damage to other miscellaneous engine parts. Also that running with the spark retarded too long causes overheating of the engine and consequent damages.

b. Riding.—Students should spend the remainder of this instruction period practicing riding and turning around on the course.

39. Eighth period.—*a. Circuit breaker.*—(1) Explain circuit breaker. When circuit breaker is in its advanced position, as controlled by handlebar grip, spark occurs at proper time for average driving conditions; when in retarded position, spark occurs later. An engine will overheat if run too long with a retarded spark. Handlebar control must be properly adjusted to advance and retard the spark fully, according to the stops on the circuit breaker.

(2) Explain how dirty, pitted, or poorly adjusted breaker points cause hard starting, misfiring, and loss of power.

(3) Explain how spark may jump to some other part of motorcycle instead of across plug gap if spark plug cables (insulation especially) are in poor condition.

b. Misfiring cylinder.—Explain and demonstrate, using a screw driver, how to locate a misfiring cylinder. If no spark occurs when a spark plug wire terminal is held about $\frac{1}{4}$ inch from the cylinder when cranking engine with ignition switch turned on, the cause may be a "dead" battery, a loose or broken wire, or dirty circuit-breaker points.

c. Riding.—Students should spend remainder of this instruction period practicing riding, save for a short time at end of period, which should be spent checking adjustment of circuit-breaker points.

40. Ninth period.—*a. Carburetor.*—(1) Explain function of carburetor, its adjustment, and that carburetor adjustment seldom requires changing. Operating faults that appear to be due to an improperly adjusted carburetor may often be traced to something else, such as improper valve-tappet adjustment, improper circuit-breaker point adjustment, or faulty spark plugs. Emphasize that changes in carburetor adjustments should not be made until absolutely certain other possible causes have been corrected by an experienced mechanic. Explain purpose of air filter and necessity for frequent cleaning and servicing.

(2) Explain that using choke too frequently causes dilution of oil in crankcase.

(3) Explain that a partly clogged gas line is usually indicated by popping in carburetor at intermediate or high speeds. The machine will slow down or stop. If a clogged gas line is suspected, it should be disconnected and cleaned or blown out.

(4) Students should be warned regarding operating motorcycle with too lean a fuel-air mixture, which usually scores cylinder walls and causes engine to "freeze."

b. Riding.—Students should spend the remainder of this instruction period practicing riding.

41. Tenth period.—*a. Air leaks in fuel system.*—(1) Describe air leaks and explain that they are found at joint where carburetor fastens to manifold and at joints where manifold fastens to engine cylinders.

(2) An air leak may be located by squirting a small quantity of gasoline around joints mentioned while engine is running slowly. If engine speeds up or slows down, it is an indication of a leak.

(3) Air leaks usually can be remedied (depending on where the leak is) by tightening carburetor fastening screws or by tightening manifold nuts.

b. Riding.—Students should spend remainder of this instruction period practicing riding. As they improve in their riding, they should, if possible, be given harder courses to ride.

42. Eleventh period.—*a. Transmission lubrication.*—(1) Describe lubrication of transmission. The oil level should be inspected every week and oil added if necessary. The same kind of oil is used in the transmission and the engine.

(2) Explain that motorcycle should never be leaning against jiffy stand when adding oil to transmission because it will be impossible to gage oil level.

b. Oil filler plug.—Demonstrate removing oil filler plug in transmission and inspecting oil level; add oil if necessary.

c. Gear shift lever.—Demonstrate how low and high gears will not mesh properly when gear shift lever is out of adjustment.

d. Riding.—Students should spend remainder of instruction period practicing riding.

43. Twelfth period.—*a. Clutch.*—(1) Explain that clutch enables driver to apply power gradually to rear wheel when gears are meshed, and permits motorcycle to be stopped without stopping engine.

(2) A slipping or dragging clutch can usually be remedied by adjusting pull rod nuts according to instructions in the manufacturer's handbook. If it becomes necessary to make corrections by using clutch adjusting screws, care should be taken to draw them all up evenly.

(3) Demonstrate effect of improper pull rod adjustment and effect of improper clutch screw adjustment.

b. Riding.—Students should spend remainder of this instruction period practicing riding.

44. Thirteenth period.—*a. Chains.*—(1) Explain that life of chains depends on care they receive; that dirty, unlubricated, and improperly adjusted chains greatly shorten life of drive sprockets.

(2) Describe how to inspect a chain for wear and damaged links.

(3) Explain importance of keeping chains properly lubricated and adjusted in order to get maximum service (the front chain is usually automatically lubricated). If chains are run too loose there will be excessive wear on chains and sprockets, and the machine will jerk at low speed. Tight chains cause excessive wear on chains and sprockets, on the sprocket shaft bearing in the engine, and on the transmission bearings.

(4) Demonstrate how to adjust front and rear chains properly and how to lubricate chains; repairing of chains (using an old chain) and connecting link, offset link, and double repair link; how adjusting rear chain changes adjustment of speedometer gear; how speedometer gear is adjusted; how adjusting rear chain changes adjustment of rear brake; how to adjust rear brakes.

b. Riding.—Students should spend remainder of this period practicing riding but should be given time at end of period to inspect and readjust chains.

45. Fourteenth period.—*a. Wheels and tires.*—(1) Explain lubrication of wheel hubs and care and tightening of wheel spokes. An

inspection of spokes should be made at least every 1,000 miles. Explain care of tires, importance of keeping tires properly inflated, and necessity of frequently checking air pressure in each tire. If tires are run underinflated, they may come off the rim and cause an accident. Underinflation increases wear, places a strain on tire carcass, and causes fabric breaks.

(2) Demonstrate how to remove wheels, how to remove and replace tires, and how to apply a patch to an inner tube (use an old tube).

(3) Have students remove wheels from a machine and then remove and replace a tire. Students should check and adjust air pressure in tires after replacing. If possible, have each student apply a patch to an old inner tube sometime during the period or later in the course of instruction.

b. Riding.—The remainder of the period should be spent in riding.

46. Fifteenth period.—*a. Brakes.*—Explain construction of brakes, when to adjust brakes, how to apply brakes to minimize hazards when road is wet or slippery, how to adjust front wheel brake, how to adjust rear wheel brake, and how to adjust side-car wheel brake.

b. Head cones.—Explain how to check head bearing cones for looseness and how to adjust them.

c. Seat.—Explain importance of keeping seat post well greased to avoid hard riding, how to stiffen seat post action by installing heavier springs, and how to weaken seat post action by installing weaker springs.

d. Adjustments.—Demonstrate adjustment of brakes (explaining in detail); adjustment of head bearing cones; and removal of seat post, calling attention to springs that must be changed to stiffen or weaken spring action.

e. Riding.—Students should spend the remainder of this period practicing riding.

47. Sixteenth period.—*a. Handlebar controls.*—Explain importance of having handlebar controls properly connected and adjusted. To obtain correct adjustment of these controls spark control must be set so that spark can be fully advanced and retarded. If spark does not fully advance, engine will lack speed and power and will overheat. The throttle control must be set so that it can be fully opened and closed. If the throttle does not close all the way, the engine will race. If the throttle does not open all the way, the engine will lack speed and power.

b. Adjustments.—Explain and demonstrate replacing a broken or damaged control wire; how to connect and adjust spark, throttle, and

oiler controls; how to lubricate handlebar controls; how to detect an improperly adjusted spark, throttle, and oiler control. If possible, the instructor should install a control wire, demonstrate control, and explain difficulties.

c. Pump and oiling system.—Explain importance of adjusting pump and oiling system. Explain oil pressure signal light (in switch panel on late model Harley-Davidson machines).

d. Riding.—Students should spend the remainder of this instruction period practicing riding.

48. Seventeenth period.—*a. Electrical system.*—(1) Explain operation of a motorcycle electrical system. Trace, by means of a wiring diagram, the light circuit, ignition circuit, and generator-battery circuit.

(2) Show that after brushes become sufficiently worn to bear against brush stops, generator will cease charging; and that when commutator becomes excessively dirty, oily, or gummy, generator will not charge properly. Commutator should be cleaned with a rag moistened with gasoline, and slots between segments should be undercut when necessary. Except in an emergency, any adjustment to the generator should always be done by an experienced mechanic.

(3) Except in an emergency, any repair or adjustment to the generator, including undercutting of mica in the slots between commutator segments, should be done by an experienced mechanic.

(4) Explain that purpose of ammeter is to measure rate of charge or discharge in amperes. Later model Harley-Davidson machines, however, use a signal light (in switch panel) to indicate generator charge and discharge.

(5) Explain that armature bearing should be lubricated occasionally with kind and grade of lubricant recommended by manufacturer. Only a small quantity of lubricant should be used, otherwise it may work out and get on the commutator.

(6) Describe care of the storage battery. Stress importance of giving battery regular attention and of keeping it filled to correct height by adding distilled water to electrolyte.

(a) Enough water should be added to raise the level of the solution about $\frac{1}{4}$ inch to $\frac{3}{8}$ inch above the top of the plates. Adding too much water will force some of the solution out through ventholes when the generator starts charging and damage the battery case and other nearby enameled parts. The battery should never be filled while the machine is leaning on a jiffy stand because too much water is apt to be added. In winter a battery should be filled only before starting for a ride so that the water and acid will have a chance to mix thor-

oughly (water added in cold weather when the motorcycle is to stand for a long time will freeze before it mixes with the electrolyte).

(b) Explain how to distinguish, with a hydrometer and voltmeter, between a charged battery and one that is discharged.

(7) Demonstrate how to remove the headlamp door and replace a faulty bulb.

(8) Students should be encouraged to trace the electrical system according to the wiring diagram in the manufacturer's handbook.

b. Riding.—Students should spend the remainder of this period practicing riding.

49. Eighteenth period.—*a. Application by students.*—Since the instructor has thoroughly explained and demonstrated what happens when various adjustments are wrong, it is advisable to test the students' ability to apply what they should have learned. Experienced assistant instructors should be used to make maladjustments on motorcycles, and the students should correct them and road-test the motorcycles. The program should be arranged so that each student has an opportunity to make various adjustments.

b. Examination.—A test in the form of an oral or written examination may also be advisable.

SECTION VI

TOOLS AND SPECIAL SHOP EQUIPMENT

Special motorcycle tools..... Paragraph 50

50. Special motorcycle tools.—Based on manufacturers' recommendations and after considering the tools available in the motor vehicle mechanic's set, unit set No. 1, and unit set No. 2, the following information on special motorcycle tools is given. These lists are tentative and apply specifically to the 1940 models of motorcycles only.

a. Indian motorcycles, M1940.—(1) For the first echelon, the tools supplied in the tool roll on each machine should be considered sufficient.

(2) For the second echelon, there are only four additional special motorcycle tools suggested, namely:

Description	Factory Part No.
Wrench, cylinder head, $\frac{3}{8}$ inch special, length 11 inches.....	101472
Wrench, socket, cylinder head bolt, special extension, $\frac{5}{8}$ inch.....	102312
Pliers, vacuum grip type, for valve covers.....	101826
Wrench, box socket, special for headlight adjusting.....	102347

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(3) For the third and fourth echelons, a complete set of tools or special items may be selected on the basis of amount of work and necessity for using these specially adapted tools to expedite repairs on a production basis. The following list is suggested:

Description	Factory part No.
Wrench, special cylinder head bolt, $\frac{5}{8}$ inch by 11 inches long	101472.
Extension, special, cylinder head bolt socket	102312.
Wrench, special, cylinder base stud nut	35W206.
Wrench, special, for clutch sprocket and transmission offset jaws, $1\frac{1}{2}$ inches.	27T350.
Wrench, intake manifold, special jaws	101134.
Cutter, cylinder valve seat refacing 35° , with pilot and handles.	101909.
Pilot, cylinder valve seat refacing 35° , with pilot and handles	101916.
Taper pilot, cylinder valve seat refacing 35° , with pilot and handles.	101917.
Cross rod, cylinder valve seat refacing 35° , with pilot and handles.	101198.
Handle, cylinder valve seat refacing 35° , with pilot and handles.	101919.
Reamer, lining, for piston pin hole and upper connecting rod bushing.	101431.
Tool, flywheel truing, with indicators and centers	22T1486.
Tool, lower connecting rod bushing lapping	22T1486.
Tool, for removing and installing connecting rod upper bushings.	24T5331.
Tool, for removing and installing lower connecting rod bushings.	42189.
Puller, special to remove timing gear pinion	33T69.
Tool, special, for assembly clutch	23T269.
Wrench, special flywheel nut	23T286.
Wrench, special, removing fork adjusting cone	9T2321.
Pliers, special valve spring cover to remove covers	101826.
Wrench, special, box socket for adjusting and assembling head light.	102347.
Tool, special, to remove and assemble spring frame assemblies	43018 and 42919.
Wrench, special wheel-bearing lock nut	31T1126.

b. Harley-Davidson motorcycles, M1940 (models 45 and 74).—

(1) For the first echelon, the tool kit furnished with each machine should normally be sufficient.

(2) For the second echelon, the following augmentation of unit sets Nos. 1 and 2 is tentatively recommended:

Unit set No. 1

Description	Factory part No.	For
Wrench, clutch nut and adjusting nut.....	12746-36.....	74 side car model.
Wrench, clutch nut and adjusting nut.....	12745-26.....	45 solo model.
Wrench, cylinder base nut.....	12050-30.....	74 side car model.
Wrench, cylinder base nut.....	12650-29.....	45 solo model.
Wrench, cylinder head bolt.....	12047-30A.....	45 and 74 models.
Wrench, manifold.....	12002-30.....	74 side car model.
Wrench, manifold.....	12003-X.....	45 solo model.
Tool, piston pin lock ring.....	12052-32.....	45 and 74 models.
Wrench, side car.....	12002-X.....	74 side car model.
Wrench, spark plug.....	11929-40.....	45 and 74 models.
Wrench, spoke nipple.....	12033-39.....	
Tool, tail lamp assembly.....	11882-39.....	45 and 74 models.
Lifter, valve spring cover.....	11959-39.....	74 side car model.
Wrench, valve spring cover.....	11806-31.....	45 solo model.

Unit set No. 2

Puller, clutch.....	12749-36.....	74 side car model.
Wrench, clutch nut and adjusting nut.....	12746-36.....	74 side car model.
Wrench, clutch nut and adjusting nut.....	12745-26.....	45 solo model.
Fixture, connecting rod clamping.....	12058-X.....	45 and 74 models.
Wrench, countershaft sprocket lock nut.	12023-X.....	74 side car model.
Wrench, cylinder base nut.....	12050-30.....	74 side car model.
Wrench, cylinder base nut.....	12650-29.....	45 solo model.
Wrench, cylinder head bolt.....	12047-30A.....	45 and 74 models.
Wrench, manifold.....	12002-30.....	74 side car model.
Wrench, manifold.....	12003-X.....	45 solo model.
Reamer, piston pin bushing.....	11915-X.....	45 and 74 models.
Tool, piston pin bushing.....	12057-X.....	45 and 74 models.
Tool, piston pin lock ring.....	12052-32.....	45 and 74 models.
Plate, piston squaring.....	11919-X.....	74 side car model.
Plate, piston squaring.....	12655-26.....	45 solo model.
Wrench, side car nut.....	12002-X.....	74 side car model.
Wrench, spark plug.....	11929-40.....	45 and 74 models.
Wrench, spoke nipple.....	12033-39.....	
Wrench, sprocket nut.....	12731-29.....	45 and 74 models.
Tool, tail lamp assembly.....	11882-39.....	45 and 74 models.
Lifter, valve spring cover.....	11959-39.....	74 side car model.
Wrench, valve cover.....	11806-31.....	45 solo model.
Compressor, valve spring.....	12053-30.....	45 and 74 models.
Wrench, wheel lug.....	12025-35.....	45 rear wheel and all 74 wheel models.

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(3) For the third and fourth echelons, the following special motorcycle tools and other items are tentatively recommended for repairs based on selection to be made by local authorities to meet actual needs:

Description	Factory part No.	For
Hone, piston pin bushing, abrasives, "fine" (4 sets to box).	11845-X-----	
Reamer—front, brake cover bushing-----	12660-26D-----	45 solo model.
Remover, cam gear shaft bushing-----	11952-36-----	45 and 74 models.
Reamer, cam gear shaft and timer drive shaft bushing.	12133-37-----	45 and 74 models.
Tools—set, carburetor clean-up-----	12012-38-----	45 and 74 models.
Device, for flywheel truing, center, movable.	11964-X-----	45 and 74 models.
Device, for flywheel truing, center, stationary.		45 and 74 models.
Tool, chain-----	12039-X-----	45 and 74 models.
Seats, valve, clearance cutter-----	11890-30-----	74 side car model.
Seats, valve, clearance cutter-----	11890-29-----	45 solo model.
Puller, clutch-----	12749-36-----	74 side car model.
Wrench, clutch nut and adjusting nut-----	12746-36-----	74 side car model.
Wrench, clutch nut and adjusting nut-----	12745-26-----	45 solo model.
Reamer, clutch gear bushing-----	12660-26B-----	45 solo model.
Fixture, clamping, connecting rod-----	12058-X-----	45 and 74 models.
Arbor, lapping, connecting rod-----	11944-36-----	74 side car model.
Arbor, lapping, connecting rod-----	11944-X-----	45 solo model.
Flywheels, copper hammer-----	11970-X-----	
Jaws—set, copper vise-----	11973-X-----	
Wrench, countershaft sprocket lock nut.	12023-X-----	74 side car model.
Wrench, crank pin nut-----	11933-X-----	74 side car model.
Lap, crankcase main bearing-----	11954-40-----	45 and 74 models.
Nut, cutter holder, and handle-----	11898-X-----	45 and 74 models.
Wrench, cylinder base nut-----	12650-29-----	45 solo model.
Wrench, cylinder base nut-----	12050-30-----	74 side car model.
Wrench, cylinder head bolt-----	12047-30A-----	45 and 74 models.
Gage, eccentric valve seat grinder with dial.	11846-X-----	45 and 74 models.
Device, flywheel truing-----	11962-X-----	45 and 74 models.
Indicators, flywheel truing device—extra set.	11969-X-----	45 and 74 models.
Gage, flywheel end play—(also to check end play of mainshaft on 45 transmission).	11967-38-----	45 and 74 models.
Wrench, flywheel nut-----	12645-29-----	45 solo model.
Bar, straightening, frame and fork-----	12082-X-----	45 and 74 models.
Puller, gear and bearing—used to remove armature bearings, gears, etc.	11849-X-----	45 and 74 models.
Gun, grease, air operated-----	11662-40-----	45 and 74 models.

Description	Factory part No.	For
Tap, handlebar end.....	12043-31.....	45 solo model.
Wrench, manifold.....	12003-X.....	45 solo model.
Wrench, manifold.....	12002-30.....	74 side car model.
Flusher, tank and oil siphon.....	12059-X.....	45 and 74 models.
Reamer, pinion shaft bushing and oiler drive shaft—74 pinion shaft and 45 and 74 oiler drive shaft.	12132-36.....	45 and 74 models.
Pilot, valve guide—standard.....	11891-30.....	74 side car model.
Pilot, valve guide—slightly oversize.....	11893-30.....	74 side car model.
Pilot, valve guide—standard.....	12621-26.....	45 solo model.
Pilot, valve guide—slightly oversize.....	12622-26.....	45 solo model.
Reamer, pinion shaft bushing.....	12135-37.....	45 solo model.
Reamer, piston pin bushing.....	11915-X.....	45 and 74 models.
Tool, piston pin bushing.....	12057-X.....	45 and 74 models.
Tool, piston pin lock ring.....	12052-32.....	45 and 74 models.
Hone, piston pin, bushing, with "fine" abrasives.	11844-X.....	45 and 74 models.
Plate, piston squaring.....	12655-26.....	45 solo model.
Plate, piston squaring.....	11919-X.....	74 side car model.
Mallet rawhide.....	12034-X.....	
Reamer, 1940—45 and all 74 front brake shackle bushings.	12044-28.....	45 and 74 models.
Reamer, 1939, front brake shackle bushings.	12665-28.....	45 solo model.
Reamer, valve guides.....	12623-26.....	45 solo model.
Reamer, valve guides.....	11894-30.....	74 side car model.
Jig, riveting, rear sprocket.....	12067-X.....	74 side car model.
Wrench, side car.....	12002-X.....	74 side car model.
Wrench, spark plug.....	11929-40.....	45 and 74 models.
Wrench, spoke nipple.....	12033-39.....	
Wrench, sprocket nut—also fits 45 crank pin nuts.	12731-29.....	45 and 74 models.
Tool, tail lamp assembly.....	11882-39.....	45 and 74 models.
Puller, tappet guide.....	11960-38.....	45 and 74 models.
Tool, to remove steel crankcase bushings.	11953-36.....	45 and 74 models.
Reamer, transmission main drive gear bushing.	12732-31.....	74 side car model.
Gage, transmission shifter fork.....	12074-39.....	74 side car model.
Compressor, valve spring.....	12053-30.....	45 and 74 models.
Tool, valve key.....	12054-30.....	45 and 74 models.
Lifter, valve spring cover.....	11959-39.....	74 side car model.
Wrench, valve cover.....	11806-31.....	45 solo model.
Stand, wheel truing—includes wheel arbors.	12028-X.....	45 and 74 models.

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Description	Factory part No.	For
Wrench, wheel lug.....	12025-35.....	45 rear wheel and all 74 wheel models.
Wrench, connecting rod lapping arbor..	11950-X.....	45 and 74 models.

[A. G. 062.11 (6-17-40)..]

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:

E. S. ADAMS,
*Major General,
The Adjutant General.*

